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<p>(54) Title: A METHOD FOR MAKING TUFTED NYLON OR POLYESTER PILE CARPETS AND CARPETS PREPARED THEREFROM</p> <p>(57) Abstract</p> <p>This invention relates to a method for making a tufted nylon or polyester pile carpet and to the resultant carpet. A thermoplastic resin consisting essentially of an ethylene copolymer having at least 8 % by weight ester groups and at least 1 % by weight carboxylic acid groups is contacted with a primary carpet backing having nylon or polyester yarn tufts. The carpet may also have a secondary backing.</p>		

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TITLE

A METHOD FOR MAKING TUFTED NYLON OR POLYESTER  
PILE CARPETS AND CARPETS PREPARED THEREFROM

5                   BACKGROUND OF THE INVENTIONField of the Invention

The present invention relates to a method for making a tufted nylon or polyester pile carpet and to the resultant carpet. In particular, the invention relates to  
10 the use of ethylene copolymers in the manufacture of such carpets, especially reactor synthesized ethylene copolymers containing both ester groups and carboxylic acid groups.

Description of Related Art

15           The manufacture of a tufted pile carpet normally involves the tufting of pile yarn into a primary carpet backing material by a conventional needle punching operation. For residential carpets, nylon and polyester  
20 yarns are the most common types of pile yarn. The carpet is then dyed, rinsed, and subjected to other standard finishing operations including stain and soil resist treatment. Subsequently, the underside of the tufted primary carpet is coated with a polymeric latex to  
25 encapsulate the yarn tufts and to provide an adhesive surface for a secondary carpet backing material. The secondary carpet backing is then laminated to the latex coated underside of the tufted primary backing, and the latex is then dried and cured. Typical synthetic polymers for preparing such a latex composition include  
30 styrene/butadiene copolymers, ethylene vinyl acetate copolymers, polyacrylates, and blends thereof. The latex also typically includes a filler material, such as calcium carbonate, silica, talc, or clay.

35           However, one disadvantage with carpets composed of such latex compositions is that after these carpets have been discarded, it is difficult to shred and break them down into their component parts for recycling purposes.

Thus, hot-melt adhesives have been developed which may be used in the place of latex for encapsulating the

tufts and laminating the tufted primary carpet backing to the secondary carpet backing, as described in Reith, U.S. Patents 4,844,765 and 4,939,036. More particularly, Reith describes using a composite hot melt adhesive comprising a primary layer in contact with the tufted primary backing and a secondary layer in contact with the secondary backing. Polyolefin and acrylic yarns, as well as nylon and polyester yarns are described as being suitable in this process. The primary layer comprises a first hot melt adhesive and the secondary layer comprises a second hot melt adhesive having a different viscosity than the first adhesive. These composite hot melt adhesives may be in the form of a composite sheet or separate sheets. Hot melt adhesives suitable for use in such a process are described by Reith as comprising a base resin, modifying or takifying resins, waxes, plasticizers, antioxidants, and fillers based on certain weight percentages.

Although, in general, such hot melt adhesives may be somewhat effective in providing tuft binding strength to carpets, it would be desirable to have a specific method for constructing a tufted nylon or polyester pile carpet.

An object of the present invention is to provide such a method and the resultant carpets. A thermoplastic resin consisting essentially of an ethylene copolymer having at least 8% by weight of ester groups and at least 1% by weight of carboxylic acid groups is used in this method.

#### SUMMARY OF THE INVENTION

Generally, the present invention provides a method for the manufacture of a tufted nylon or polyester pile carpet, comprising the steps of:

- a) contacting a thermoplastic resin consisting essentially of an ethylene copolymer having at least 8% by weight of ester groups and at least 1% by weight of carboxylic acid groups with a primary carpet backing having nylon or polyester yarn tufts;

b) heating the thermoplastic resin to a temperature above the melting point of the ethylene copolymer;

c) maintaining the thermoplastic resin in contact with the primary carpet backing at a temperature above the melting point of the ethylene copolymer and under a pressure and a period of time sufficient to cause the resin to encapsulate the bases of the yarn tufts; and

d) cooling the tufted carpet backing and thermoplastic resin to solidify the resin.

10 Preferably, the thermoplastic resin has a melt index of 2 to 50 dg/min and contains 50 to 100% by weight of the ethylene copolymer. Typically, the ethylene copolymer will be composed of 10-25% by weight ester groups and 2-20% by weight carboxylic acid groups, wherein  
15 the total amount of ester and carboxylic acid groups is no greater than 35% by weight of the copolymer. Suitable materials for the primary backing include polypropylene fabrics.

In a preferred embodiment, the method involves  
20 first extruding the thermoplastic resin in molten form onto a secondary carpet backing, The coated secondary backing is then contacted with a primary carpet backing having tufted nylon or polyester yarns under a pressure and for a period of time sufficient to cause the molten  
25 thermoplastic resin to encapsulate the bases of the yarn tufts and to bond the primary and secondary backings together.

In other embodiments, the thermoplastic resin may be extruded onto the primary backing, or the resin may be  
30 in the form of a sheet which is first laminated onto either the primary or secondary carpet backing.

The secondary backing may be first coated with an ethylene/vinyl ester copolymer, ethylene/alkyl (meth)acrylate copolymer, or an ethylene/olefin copolymer  
35 before the thermoplastic resin is applied to the secondary backing. In such a case, the adhesive may be in molten form or in the form of a laminated sheet.

The present invention also encompasses tufted pile carpets. Such carpets may comprise a primary carpet

backing, wherein tufts of nylon or polyester yarn project from the surface and the underside of the backing is coated with a thermoplastic resin consisting essentially of an ethylene copolymer having at least 8% by weight ester groups and at least 1% by weight carboxylic acid groups. These tufted pile carpets may also include a secondary carpet backing, wherein said secondary backing is bonded to the underside of the tufted primary backing by means of the thermoplastic resin.

#### DETAILED DESCRIPTION OF THE INVENTION

The present invention relates to a method for making a tufted pile carpet having nylon or polyester yarn tufts. In this method, a tufted primary carpet backing is contacted with a thermoplastic resin consisting essentially of an ethylene copolymer having at least 8% by weight of ester groups and at least 1% by weight of carboxylic acid groups at a temperature above the melting point of the ethylene copolymer. The molten resin is maintained in contact with the tufted primary carpet backing for a period of time sufficient to cause the resin to encapsulate the bases of the nylon or polyester tufts. Subsequently, or simultaneously a secondary carpet backing may be laminated to the tufted primary backing.

The primary carpet backing is in the form of a backing material having tufts of nylon or polyester yarns projecting from its surface. The projecting tufts have tuft bases stitched into the primary backing and tuft tips which form the carpet face. The backing may be a woven material made from natural or synthetic materials, examples of which are jute, wool, rayon, polyamides, polyesters and polyolefins. Nonwoven backings may also be used. In preferred embodiments, the primary backing is a fabric woven from tapes or yarns and is in the form of a flat material with substantially uniform thickness.

In the present invention, only nylon or polyester yarns should be tufted into the primary carpet backing for reasons discussed below. The filaments comprising such yarns may be prepared by techniques known in the trade,

and the yarns may be bulked and twisted accordingly. The yarns may be tufted into the primary backing material using a conventional needle punching procedure. The resulting tufts may be in the form of loops or loops that have been slit, and the tuft density, tuft thickness, and tuft height may all be varied, depending on the desired carpet quality and style.

The key feature of the present invention is the use of a distinctive thermoplastic resin which offers several advantages over conventional hot melt adhesives for providing good tuft binding strength in the finished carpet. As a result, the nylon or polyester tufts may not be easily pulled out from the carpet face.

The thermoplastic resin of this invention consists essentially of an ethylene copolymer which is a reactor synthesized ethylene copolymer, as opposed to for instance a grafted copolymer. Generally, the amount of ethylene copolymer in the resin formulation should be at least 50% by weight, and in some instances, the resin may consist entirely of the ethylene copolymer. The ethylene copolymer contains at least 8% by weight of ester groups and at least 1% by weight of carboxylic acid groups.

It is believed that this resin provides for good tuft binding strength in the carpet, because it is capable of bonding to the nylon and polyester tufts by both a mechanical and chemical bonding means, unlike conventional hot melt adhesives.. Mechanical bonding is achieved by heat-activating the resin to a temperature above the melting point of the ethylene copolymer. The molten resin then penetrates the bases of the fiber tufts to encapsulate them and mechanically lock them into place. In addition, it is believed that the resin has a high chemical affinity to the nylon and polyester tufts due to the presence of the carboxylic acid groups in the ethylene copolymer. These carboxylic acid groups may bond to the polyamide or polyester backbone by hydrogen bonding and may bond to the free amine ends in the polyamide backbone by covalent bonding to form amide linkages. As a result of this chemical action, good tuft binding strength is

still obtained even if for some reason, only a small amount of adhesive is able to physically encapsulate the tufts.

The ester groups in the ethylene copolymer may be derived from vinyl ester monomers, examples of which are vinyl alkylates, such as vinyl acetate, vinyl propionate, and vinyl butyrate; and alkyl (meth)acrylates, such as methyl (meth)acrylate, propyl (meth)acrylate, isobutyl (meth)acrylate, and n-butyl (meth)acrylate. The carboxylic acid groups may be derived from such acids as acrylic acid, methacrylic acid, and itaconic acid.

Reactor synthesizing methods using high pressure reactors which are known in the art may be used to synthesize the ethylene copolymers of this invention.

The ethylene copolymer contains least 8% by weight ester groups, especially 8-25% by weight, and preferably at least 10% by weight ester groups based on the weight of the ethylene copolymer. In addition, the ethylene copolymer has at least 1% by weight of carboxylic acid groups, especially 1-20% by weight, and preferably at least 2% by weight of carboxylic acid groups based on the weight of the ethylene copolymer. The total amount of ester and carboxylic acid groups should comprise no greater than 35% by weight of the ethylene copolymer. The ethylene copolymer may contain additional comonomers, such as, propylene, butene, hexene, octene, acrylamide, or carbon monoxide. It is preferred that any additional comonomers be in small amounts, i.e., no greater than about 10% by weight of the ethylene copolymer.

It may be desirable, and in some instances particularly preferred, that the ethylene copolymer be blended with another polymer to form the thermoplastic resin. When the ethylene copolymer is blended, the concentration of the ester groups and carboxylic acid groups in the blend should still be at least 8% by weight and at least 1% by weight, respectively. Suitable polymers which may be blended with the ethylene copolymer include, ethylene/vinyl acetate copolymers, ethylene/acrylic acid copolymers, ethylene/alkyl acrylate



copolymers, low density polyethylene, very low density polyethylene (VLDPE), ethylene/butene copolymers, ethylene/hexene copolymers, ethylene/octene copolymers, ethylene/acrylamide copolymers, polypropylene copolymers, 5 ethylene/propylene copolymers, and ethylene/propylene/diene (EPDM) copolymers.

The thermoplastic resins of this invention have a relatively high melt viscosity and corresponding low melt index versus conventional hot melt adhesives. 10 Particularly, the melt index of the thermoplastic resin used in this invention should be less than about 500 dg/min, and preferably less than 200 dg/min, as measured by the procedure of ASTM D-1238 (Condition E). It is preferred that the melt index be at least 2 dg/min, and 15 especially in the range of 2-50 dg/min. As a result of this high melt viscosity, the molten resin does not flow as rapidly into the secondary backing web as conventional hot melt adhesives, and more resin is available to penetrate and encapsulate the tufts in the primary 20 backing.

The thermoplastic resin may also contain a small amount of elastomer which is not miscible with the ethylene copolymer, especially in amounts of 10-30% by weight of the resin. Other additives for imparting 25 different functionalities may also be added to the resin such as antioxidants, flame retardants, antistats, and antimicrobial agents. Discarded carpet pieces may be finely shredded and ground to a suitable size and then added to the resin.

30 The thermoplastic resin may be contacted with the tufted primary carpet backing by a variety of methods. Preferably, the resin, in molten form, is extruded directly onto the secondary carpet backing. In such a case, the ethylene copolymer may be heated to its molten 35 state in a mixing vessel, while filler, additives, and other polymers, as discussed above, are added. Due to the high melt viscosity of the resin, it is important the ingredients be blended in extrusion or batch blending equipment, such as a Haake Brabender, which provides

sufficient shear to properly blend the melt. The molten mixture is then extruded or cast uniformly through a die directly onto the secondary backing. Generally, the amount of resin applied to the secondary backing is  
5 greater than 0.25 ounces per square yard of secondary backing material and preferably about 2.5 to 12 oz/yd<sup>2</sup> is applied. Examples of suitable secondary carpet backing materials for use in this invention include jute, woven tapes of polypropylene, plain woven polypropylene fabrics,  
10 felts including felts of shredded used carpet, and thermoplastic polymer films. The coated secondary backing may then be passed between two pressure metal rolls, whereby the molten layer is pressed into the secondary backing and is cooled to a point where it solidifies.

15 The coated secondary backing is subsequently pressed against the tufted primary backing and the resin is heated to a temperature at least above the melting point of the ethylene copolymer. The molten resin is then maintained in contact with the tufted primary backing  
20 under a pressure and for a period of time sufficient to cause the molten resin to encapsulate the bases of the yarn tufts and to bond the primary and secondary backings together. The molten resin should penetrate the yarn tufts sufficiently to encapsulate the bases of the tufts  
25 and to lock the tufts into place.

This heat-activation and lamination process may be simultaneously carried out using equipment known in the trade. For example, conventional curing ovens that are often used in operations where the adhesive consists only  
30 of a polymeric latex between the primary and secondary backings are also suitable for the present invention. The temperature inside such ovens is generally in the range of 300 to 450°F. Alternatively, the backings may be passed between heated pressure or nip rolls. The finished carpet  
35 is then cooled to a point, where the resin solidifies. This cooling step may be conducted by passing the carpet through a zone of air at ambient temperature.

In another embodiment, the heat-activation and lamination process are carried out in two separate steps.

In such an instance, the coated backing is first heated to a temperature at least above the melting point of the ethylene copolymer in order to activate the resin. The secondary backing containing the heat-activated resin is then pressed against the tufted primary backing under a sufficient pressure and for a sufficient period of time, as described above.

It is also recognized that it is not necessary for the resin to first be cooled to a solid state. Rather, the secondary backing may be pressed against the tufted primary backing immediately after the molten resin has been extruded onto the secondary backing, while the resin is still in its molten state.

Alternatively, the thermoplastic resin may be in the form of a sheet which is first laminated onto the secondary backing. In such a process, the resin is extruded through a circular or flat die and cooled to a point where it solidifies to form a sheet which may be wound onto a core and stored for future use. The sheet is then laid onto the secondary backing, heated, and laminated onto the backing by applying pressure. For example, the backing containing the sheet may be passed between pressure or nip rolls. The secondary backing is then pressed against the primary backing in a manner as described above.

Furthermore, in some instances, it may be desirable to apply the thermoplastic resin to the tufted primary carpet backing, rather than to the secondary backing. The tufted primary backing may then be laminated to a secondary backing in the above-described manner, depending upon the desired carpet construction. For some carpets, such as carpets intended for automotive applications, the carpet will often not have a secondary backing material.

In any event, it is important that the molten thermoplastic resin be maintained in contact with the tufted primary carpet backing under such conditions (pressure and time) that the resin may encapsulate the bases of the yarn tufts. This period of time should be

at least 0.5 seconds and preferably 1-10 seconds. Typically, a period of 1-2 seconds is used, but the exact period of time will depend on the melt flow characteristics of the resin. In instances where the tufted primary backing is being laminated to a secondary backing, this period of time should be at least about 2 seconds, and the pressure applied should be at least about 2 psi.

The melting point of the ethylene copolymer composition used in the process of the invention needs to be at least 50°C, and since this melting point may affect the dimensional stability of the carpet, higher melting points are preferred, especially above 70°C. However, the ethylene copolymer should generally have a low melting point, since such compositions require less heat in order to soften/melt and penetrate the tufts. Thus, these lower melting points, result in the use of lower temperatures during the manufacturing process or the ability to operate the process at higher operating speeds. The ethylene copolymer compositions should also melt at a temperature below the temperature at which distortion of the carpet backings and/or tufts may occur. For instance, if the carpet backing is polypropylene, then the melting point of the composition should be below about 140°C.

It is understood that the secondary backing may first be coated with any suitable adhesive in order to provide additional stability and hand to the finished carpet. Subsequently, the thermoplastic resin of this invention is applied onto the adhesive-coated secondary backing. Examples of suitable adhesives for coating the secondary backing include ethylene/vinyl ester copolymers, such as ethylene/vinyl acetate, ethylene/alkyl (meth) acrylate copolymers, such as ethylene methyl acrylate, and ethylene/olefin copolymers, such as very low density polyethylene (VLDPE), which may be unfilled polymers but in preferred embodiments are filled polymers. Examples of suitable fillers include calcium carbonate, barium sulfate and talc.

The present invention is further illustrated by the following examples, but these examples should not be construed as limiting the scope of the invention.

#### Testing Methods

- 5 Melt Index: The melt index of the thermoplastic resin was determined according to the procedure of ASTM D-1238 (Condition E).

- 10 Tuft Binding Strength: The tuft binding strength of the carpet samples were tested in accordance with ASTM Test Method D-1335.

Tuft Encapsulation: The tuft encapsulation of the carpet samples were evaluated by visual inspection with the aid of magnification, if needed. Results were reported as Good, Fair, or Poor.

15

#### EXAMPLES

In the following examples 1-3, tufted primary carpet backings prepared in the below-described manner were used to make finished carpet samples.

- 20 A BCF (bulked continuous filament) nylon 6,6 yarn of 1410 total denier and composed of 68 filaments (trilobal cross-section) was produced by a conventional process. Two of these yarns were plied and twisted to provide a yarn having a balanced twist of 3.5 turns per  
25 inch (tpi). The resultant yarn was then conventionally heat-set in a "SUPERBA" heat-set apparatus at 270°F (132°C). A cut-pile tufted carpet was constructed from the heat-set yarn using "POLYBAC", a woven polypropylene primary backing, available from Patchogue Plymouth (a  
30 division of Amoco). The carpet was constructed to the following specifications: 40 oz./yd<sup>2</sup>, 3/4" pile height, 1/8 gauge, and 8.25 stitches per inch. This carpet was dyed to a light blue-grey shade using a Kuster's Fluidyer on a continuous dye line. A conventional  
35 continuous dye process at 400% wet pick-up, and dye auxiliaries were used for dyeing the carpet (pH =6.0). The color formula was the following (based on the weight of the carpet):

0.02% Tectilon Blue 4R (200%)  
0.006% Tectilon Red 2B (200%), and  
0.0045% Tectilon Orange 3G (200%)

5           After dyeing, the carpet was rinsed and extracted.  
The carpet was then treated with a bath containing a  
commercially available stain resist agent, SR-200 from  
DuPont, on a Kuster's Flexnip. This stain resist agent  
is a mixture of hydrolyzed styrene/maleic anhydride  
10 copolymer and a sulfonated phenol formaldehyde  
condensate, as described in Fitzgerald et al., U.S.  
Patent 4,883,839. The bath was prepared by water  
dilution of the stain resist chemical SR-200 and adjusted  
to a pH of 2.3 using sulfamic acid. The bath was applied  
15 in the Kuster's Flexnip at about 80°F and at 400%  
wet pick-up owf (on weight of fiber). The bath was  
applied at 3.75% owf. The carpet was then subjected to  
steaming in a vertical steamer for a residence time of 3  
minutes. After the steamer, the carpet was rinsed and  
20 extracted. The carpet was subsequently treated with  
NRD-342 fluorochemical, available from DuPont, in a  
conventional spray application, and the carpet was dried  
in an oven.

"ACTIONBAC", a woven polypropylene secondary  
25 backing, commercially available from Patchogue Plymouth (a  
division of Amoco), was used for preparing the finished  
samples. Different thermoplastic resins were applied to  
the secondary backing either in the form of film  
lamination or via extrusion coating, as described below.

30 EXAMPLE 1

This example demonstrates preparing a finished  
carpet sample having a "BYNEL" 2002 film laminated onto  
the secondary backing.

A 9 mil thick film of the thermoplastic resin,  
35 "BYNEL" 2002 (ethylene/10% isobutyl acrylate/10%  
methacrylic acid copolymer, melt index = 10 g/10 min), a  
commercially available product from the DuPont Co., was  
laminated to an "ACTIONBAC" secondary backing using a  
Hoffman Utility Press, Model XCO-56, at 212°F for a period

of 2 minutes. The "BYNEL" 2002 film-laminated secondary backing was then laminated to a tufted primary backing sample using the same Hoffman Press at 212°F for a period of 2 to 3 minutes to make a finished carpet sample.

5           The finished carpet sample was tested for tuft bind strength and the results are reported below in Table I.

#### EXAMPLE 2

10           This example demonstrates preparing a finished carpet sample having a secondary backing which has been extrusion coated with "BYNEL" 2022 thermoplastic resin.

          The "ACTIONBAC" secondary backing was extrusion coated with a single layer of "BYNEL" 2022 (ethylene/10% isobutyl acrylate/10% methacrylic acid copolymer, melt index = 35 g/10 min), a commercially available product from the DuPont Co., at a thickness of about 6 mils. The single layer coated sample was then laminated to a tufted primary backing sample using the Hoffman Utility Press, Model XCO-56, at 212°F for a period of 2 to 3 minutes to make a finished carpet sample

          The finished carpet sample was tested for tuft bind strength and the results are reported below in Table I.

#### 25   EXAMPLE 3

          This example demonstrates preparing a finished carpet sample having a secondary backing which has first been coated with an adhesive and subsequently coated with "BYNEL" 2022 thermoplastic resin.

30           The "ACTIONBAC" secondary backing was extrusion coated at a thickness of about 12 mils with "KELDAX" 6868 (23% ethylene vinyl acetate /20% CaCO<sub>3</sub> /56% BaSO<sub>4</sub>), a commercially available product from the DuPont Company. A layer of "BYNEL" 2022 was then extrusion coated at a thickness of about 6 mils onto the "KELDAX" layer in the above-described manner. The "BYNEL"/"KELDAX" extrusion coated secondary backing was then laminated to a tufted primary backing sample in such a manner that the "BYNEL" 2022 layer was pressed against the tufted primary backing

using the same Hoffman Press at 212°F for a period of 2 to 3 minutes to make a finished carpet sample.

The finished carpet sample was tested for tuft bind strength and the results are reported below in Table I.

#### EXAMPLE 4

This example demonstrates preparing a finished carpet sample having a secondary backing which has been coated with the thermoplastic resin, "BYNEL" 2022 and laminated to a tufted primary backing using a lab prototype latex curing oven.

"KELDAX" 6868 was extrusion coated onto a secondary backing at a nominal thickness of 11-12 mils. The secondary backing was then further coated with 6 mils "BYNEL" 2022 resin, as described in above Example 3. The coated secondary backing sample was then preheated using infra red heaters for just enough time (approximately 15 seconds) to melt/soften the upper "BYNEL" 2022 layer. A tufted primary backing was then brought in contact with the secondary backing such that the molten "BYNEL" 2022 layer was pressed against the tufted primary backing. Steam at 90 psig was then used to preheat the entire carpet assembly. The carpet assembly was then passed through two press rolls exerting a pressure of about 5 psi at a minimum contact time of 1 to 2 seconds at 5 feet/min. The carpet was then moved through a lab prototype latex curing oven heated to 160°C for a residence time of 1 to 6 min. The finished carpet was then allowed to reach room temperature.

The finished carpet sample was tested for tuft bind strength and the results are reported below in Table I.



TABLE I

	<u>Example</u>	<u>Tuft Bind Strength</u>	<u>Tuft Encapsulation</u>
	1	5.16 lbs.	Good
5	2	4.99 lbs.	Good
	3	4.97 lbs.	Good
	4	4.30 lbs	Good

**CLAIMS:**

1. A method for the manufacture of a tufted nylon or polyester pile carpet, comprising the steps of:

- a) contacting a thermoplastic resin consisting  
5 essentially of an ethylene copolymer having at least 8% by weight of ester groups and at least 1% by weight of carboxylic acid groups with a primary carpet backing having nylon or polyester yarn tufts;
- b) heating the thermoplastic resin to a temperature  
10 above the melting point of the ethylene copolymer;
- c) maintaining the thermoplastic resin in contact with the primary carpet backing at a temperature above the melting point of the ethylene copolymer and under a pressure and a period of time sufficient to cause the  
15 resin to encapsulate the bases of the yarn tufts; and
- d) cooling the tufted carpet backing and thermoplastic resin to solidify the resin.

2. A method for the manufacture of a tufted pile  
20 carpet, comprising the steps of:

- a) extruding a thermoplastic resin consisting essentially of an ethylene copolymer having at least 8% by weight of ester groups and at least 1% by weight of carboxylic acid groups, in molten form, onto a secondary  
25 carpet backing;
- b) contacting the secondary backing with a tufted primary carpet backing having nylon or polyester tufts under a pressure and for a period of time sufficient to cause the molten resin to encapsulate the bases of the  
30 tufts and to bond the primary and secondary backings together; and
- c) cooling the carpet backings and thermoplastic resin to solidify the resin.

35 3. A method for the manufacture of a tufted pile carpet, comprising the steps of:

- a) applying a thermoplastic resin consisting essentially of an ethylene copolymer having at least 8% by weight of ester groups and at least 1% by weight of

carboxylic acid groups, in sheet form, onto a secondary carpet backing;

b) heating the thermoplastic resin to a temperature above the melting point of the ethylene copolymer;

5 c) contacting the secondary backing with a tufted primary carpet backing having nylon or polyester tufts under a pressure and for a period of time sufficient to cause the molten resin to encapsulate the bases of the tufts and to bond the primary and secondary backings  
10 together; and

d) cooling the carpet backings and thermoplastic resin to solidify the resin.

4. The method of claims 1, 2, or 3, wherein the  
15 thermoplastic resin has a melt index in the range of 2-50 dg/min.

5. The method of claims 1, 2, or 3, wherein the ethylene copolymer comprises 10 to 25% by weight of ester  
20 groups and 2 to 20% by weight of carboxylic acid groups.

6. The method of claims 1, 2, or 3, wherein the thermoplastic resin contains 50 to 100% by weight of the ethylene copolymer.  
25

7. The method of claims 2, or 3, wherein the secondary carpet backing is first coated with an adhesive selected from the group of ethylene/vinyl ester copolymers, ethylene/alkyl (meth)acrylate copolymers, and  
30 ethylene/olefin copolymers prior to extruding the thermoplastic resin onto the secondary backing.

8. A tufted pile carpet, comprising a primary carpet backing having a surface and an underside, wherein  
35 tufts of nylon or polyester yarn project from said surface and said underside is coated with a thermoplastic resin consisting essentially of an ethylene copolymer having at least 8% by weight ester groups and at least 1% by weight carboxylic acid groups.

9. A tufted pile carpet, comprising:

a) a tufted primary carpet backing having a surface  
and an underside, wherein tufts of nylon or polyester yarn  
5 project from said surface; and

b) a secondary carpet backing, wherein said  
secondary backing is bonded to the underside of the tufted  
primary backing by means of a thermoplastic resin  
consisting essentially of an ethylene copolymer having at  
10 least 8% by weight ester groups and at least 1% by weight  
carboxylic acid groups.

15

## AMENDED CLAIMS

[received by the International Bureau on 13 March 1995 (13.03.95);  
original claim 6 cancelled; original claims 1,2 and 3 amended;  
original claims 7,8 and 9 amended and renumbered as claims 6,7 and 8;  
remaining claims unchanged (3 pages)]

1. A method for the manufacture of a tufted nylon  
or polyester pile carpet, comprising the steps of:

- a) contacting a thermoplastic resin consisting  
5 substantially 100% of an ethylene copolymer having at  
least 8% by weight of ester groups and at least 1% by  
weight of carboxylic acid groups with a primary carpet  
backing having nylon or polyester yarn tufts;
- b) heating the thermoplastic resin to a temperature  
10 above the melting point of the ethylene copolymer;
- c) maintaining the thermoplastic resin in contact  
with the primary carpet backing at a temperature above the  
melting point of the ethylene copolymer and under a  
pressure and a period of time sufficient to cause the  
15 resin to encapsulate the bases of the yarn tufts; and
- d) cooling the tufted carpet backing and  
thermoplastic resin to solidify the resin.

2. A method for the manufacture of a tufted pile  
20 carpet, comprising the steps of:

- a) extruding a thermoplastic resin consisting  
substantially 100% of an ethylene copolymer having at  
least 8% by weight of ester groups and at least 1% by  
weight of carboxylic acid groups, in molten form, onto a  
25 secondary carpet backing;
- b) contacting the secondary backing with a tufted  
primary carpet backing having nylon or polyester tufts  
under a pressure and for a period of time sufficient to  
cause the molten resin to encapsulate the bases of the  
30 tufts and to bond the primary and secondary backings  
together; and
- c) cooling the carpet backings and thermoplastic  
resin to solidify the resin.

35 3. A method for the manufacture of a tufted pile  
carpet, comprising the steps of:

- a) applying a thermoplastic resin consisting  
substantially 100% of an ethylene copolymer having at  
least 8% by weight of ester groups and at least 1% by

weight of carboxylic acid groups, in sheet form, onto a secondary carpet backing;

b) heating the thermoplastic resin to a temperature above the melting point of the ethylene copolymer;

5 c) contacting the secondary backing with a tufted primary carpet backing having nylon or polyester tufts under a pressure and for a period of time sufficient to cause the molten resin to encapsulate the bases of the tufts and to bond the primary and secondary backings together; and

10 d) cooling the carpet backings and thermoplastic resin to solidify the resin.

4. The method of claims 1, 2, or 3, wherein the  
15 thermoplastic resin has a melt index in the range of 2-50 dg/min.

5. The method of claims 1, 2, or 3, wherein the ethylene copolymer comprises 10 to 25% by weight of ester  
20 groups and 2 to 20% by weight of carboxylic acid groups.

6. The method of claims 2, or 3, wherein the secondary carpet backing is first coated with an adhesive selected from the group consisting of ethylene/vinyl ester  
25 copolymers, ethylene/alkyl (meth)acrylate copolymers, and ethylene/olefin copolymers prior to extruding the thermoplastic resin onto the secondary backing or applying the thermoplastic resin in sheet form onto the secondary backing.

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7. A tufted pile carpet, comprising a primary carpet backing having a surface and an underside, wherein tufts of nylon or polyester yarn project from said surface and said underside is coated with a thermoplastic resin  
35 consisting substantially 100% of an ethylene copolymer having at least 8% by weight ester groups and at least 1% by weight carboxylic acid groups.

8. A tufted pile carpet, comprising:

5 a) a tufted primary carpet backing having a surface and an underside, wherein tufts of nylon or polyester yarn project from said surface; and

b) a secondary carpet backing, wherein said secondary backing is bonded to the underside of the tufted primary backing by means of a thermoplastic resin consisting substantially 100% of an ethylene copolymer  
10 having at least 8% by weight ester groups and at least 1% by weight carboxylic acid groups.

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## INTERNATIONAL SEARCH REPORT

Intern al Application No  
PCT/US 94/12726A. CLASSIFICATION OF SUBJECT MATTER  
IPC 6 D06N7/00

According to International Patent Classification (IPC) or to both national classification and IPC

## B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)  
IPC 6 D06N B32B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	DATABASE WPI Week 8337, Derwent Publications Ltd., London, GB; AN 83-761910 (37) & JP,A,58 132 176 (SUMITOMO CHEMICAL KK) 6 August 1983 see abstract ---	8,9
X	DATABASE WPI Week 8036, Derwent Publications Ltd., London, GB; AN 80-63357C & JP,A,55 098 972 (TAKEDA CHEMICAL IND KK) 29 July 1980 see abstract --- -/--	8

☒ Further documents are listed in the continuation of box C.☒ Patent family members are listed in annex.

## \* Special categories of cited documents :

- \* "A" document defining the general state of the art which is not considered to be of particular relevance
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Date of the actual completion of the international search

18 January 1995

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## INTERNATIONAL SEARCH REPORT

Inter: 1st Application No

PCT/US 94/12726

## C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	CHEMICAL ABSTRACTS, vol. 109, no. 2, 11 July 1988, Columbus, Ohio, US; abstract no. 7942m, 'ETHYLENE COPOLYMER BACKING COMPOSITIONS FOR AUTOMOBILES AND TILES' page 69 ;column 1 ; see abstract & JP,A,63 028 980 (NIPPON OIL CO.,LTD.) 6 February 1988 ---	1,3,4,6, 8,9
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A	DATABASE WPI Week 9301, Derwent Publications Ltd., London, GB; AN 93-005146 (01) & JP,A,4 333 670 (AICHI SEIKO KK) 20 November 1992 see abstract ---	1,2,8
A	DATABASE WPI Week 8412, Derwent Publications Ltd., London, GB; AN 84-071064 (12) & JP,A,59 024 735 (HAYASHI TERENPU KK) 8 February 1984 see abstract ---	8
A	GB,A,1 249 611 (E.I. DU PONT DE NEMOURS AND COMPANY) 13 October 1971 see page 3, line 57 - line 91; claims 1-7,28,29,32,34,35; example 1 -----	1,4-6,8, 9

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International Application No  
PCT/US 94/12726

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US-A-4844765	04-07-89	US-A- 4939036	03-07-90
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